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The American Biology Teacher

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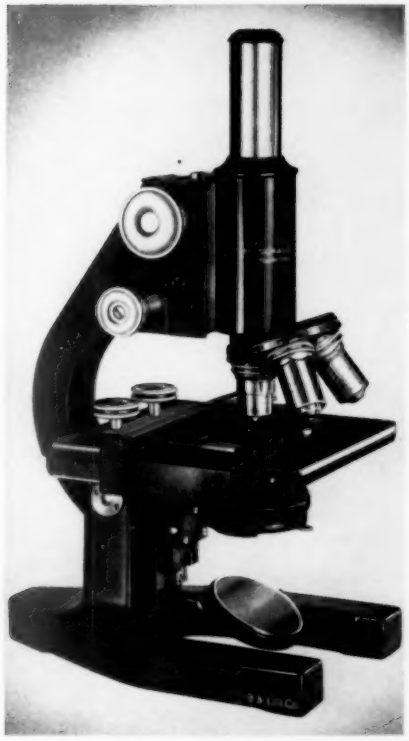

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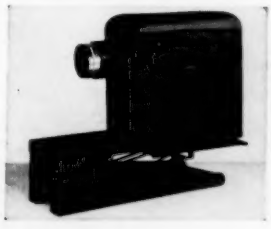

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Publication of The National Association of Biology Teachers.
Issued monthly eight times during the school year from October to May.
Publication Office—N. Queen St. and McGovern Ave., Lancaster, Pennsylvania.

Correspondence concerning manuscripts may be addressed to any of the Associate Editors or directly to the Editor-in-Chief. Books and pamphlets for review should be sent to the Editor-in-Chief. Subscriptions, renewals, and notices of change of address should be sent to P. K. Houdek, Secretary-Treasurer, Robinson, Ill.

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The American Biology Teacher

Vol. 3 NOVEMBER, 1940 No. 2

Biology through the Abattoir

I. The Mammalian Heart

HELEN I. BATTLE
University of Western Ontario, London, Canada

"The heart is deceitful above all things and desperately wicked: who can know it?" Jeremiah XVII, 9.

To the biology teacher this biblical reference has too frequently a very concrete meaning insofar as it may remotely be applied to the interpretation of the anatomical and physiological relationships of the mammalian heart by junior students. Charts and models, both stationary and mechanical, serve a very useful purpose in the elucidation of cardiac structure. They are, however, at best too static and insufficiently realistic to incite a fundamental interest resulting in a subsequent understanding on the part of the average student. Similarly, dissections of small mammals such as the rabbit or cat, are inadequate as demonstrations for the inexperienced, and especially for large classes where individual material is not available. The heart from a large mammal has proved to be an ideal preparation since the student can clearly observe structural details, valvular action, and compare the character of the walls of large arteries and veins.

The beef heart-lung preparation may readily be obtained at any abattoir by explaining your particular requirements to a butcher, preferably one who does his own slaughtering. Hog or sheep material is almost equally useful. Simply enquire for the heart, intact in its sac, together with the lungs and windpipe, including the base of the tongue. The inclusion of the lungs insures that the great vessels about the heart will be intact. This material has invariably proved to be a successful demonstration for elementary classes in zoology, physiology, hygiene and pre-nursing courses. It is quite similar in structure to the human and sufficiently large to permit a dozen or more individuals to observe the dissection and experiments at one time. Frequently students wish to assist in the actual dissection, and even the more timid are less reticent about doing so

on the customary "hearts" and "lights" of the butcher shop than upon embalmed animals.

The following outline designed as a guide for the study of the heart is arranged in the order which has proved most satisfactory, following several years' practical experience. It is based on the beef preparation but is applicable with minor exceptions, to all common mammals.

The *thymus*, a ductless gland, pale greyish-pink in color and roughly divisible into right and left lobes may still be present lying ventral to the trachea and molded to the large vessels at the front of the heart. It is frequently sold under the name "sweet breads." Remove the thymus and clear off fat surrounding the pericardial sac by pulling firmly with the fingers. The *pericardium* is a strong inelastic fibrous sac surrounding the heart and the bases of the great blood vessels. Slit it open on the ventral surface and test its tensile strength. The latter is indicative of its function, namely that of preventing the heart from overdistention. If the preparation is sufficiently fresh, a small quantity of *pericardial fluid* will be present. It moistens the inner surface of the heart thus diminishing friction which would otherwise occur with each beat.

The greater portion of the heart, namely the *right* and *left ventricles*, constitute an irregularly flattened cone, having a posterior pointed apex and a broad anterior base. The division between these two chambers is evident externally by an indistinct fat-filled groove extending from slightly to the left of the middle of the base, obliquely to the right margin of the heart, some distance anterior to the apex. Encircling the bases of the ventricles is another fat-laden groove, anterior to which lie the thin-walled *right* and *left atria*. From each atrium an *auricular appendix*, appearing as a conical outpouching extends medially and slightly posteriorly over the ventricle. This appendage has a scalloped margin and resembles the human ear, hence the term "auricula" (Latin—little ear). In the fat-laden grooves which mark the partitions dividing the heart into its four constituent chambers lie branches of the *coronary arteries* and *veins*. These may be observed ramifying over the surface of the ventricles whose musculature they supply with food, including oxygen. Ligation of the coronary arteries near their point of origin from the base of the aorta, invariably causes stoppage of the heart: the ventricular muscle is irregularly contracted (fibrillation) as is frequently the case in death from electrical shock. The coronary veins enter the right auricle.

The large *pulmonary artery* springs from the base of the right ventricle and passes forward between the two atria. It arches to the left and disappears before forking, one branch passing to each lung. Dorsal to the pulmonary artery is another slightly larger arterial trunk, the *aorta*, which arises from the base of the left ventricle. A strong *arterial ligament* binds these two vessels together. A large artery, the *common brachiocephalic trunk* is given off from the right side of the aorta at the anterior border of the heart. It gives rise to branches which supply the fore-limbs and head.

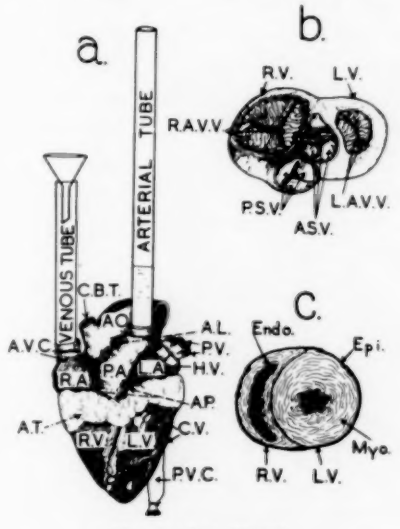
Turn the apex of the heart forward and observe the bases of the great thin-walled veins. Insert a finger or large blunt probe into the cut ends of the *posterior vena cava* below and the *anterior vena cava* above and trace their entrance into the right atrium. The venae cavae or "hollow veins" were so called by the older anatomists because they were usually found empty after

death. The hemiazygos, a smaller vein (in the ox) which returns blood from the thorax may be located along the posterior border of the left atrium as it passes medially to enter the right atrium. In the posterior wall of the left atrium note the entrances of the four or five (sometimes more) *pulmonary veins* and trace the latter to their respective lobes of the lungs.

It is possible to measure the thickness of the walls and the respective diameters of the large arterial and venous trunks and in this way to correlate their functions. Observe the heavy yellow elastic tissue of the arteries.

Next take a glass tube approximately 2 to 4 cm. in diameter and 20 cm. in length, and tie it into the anterior vena cava. Ligate the posterior vena cava and the smaller left hemiazygos vein. Similarly tie a second tube about 30 to 40 cm. in length into the pulmonary artery which has previously been cut transversely about 6 to 8 cm. from its base. Support both tubes and the heart in a vertical position with clamps. (Fig. a). Fill the venous tube with water, and at the same time compress the ventricle rhythmically by hand. Add more water as the level falls in the venous tube. Note that it rises in the arterial tube and each time the compression ceases the water remains at a constant level because its return to the ventricle is prevented by valves in the pulmonary artery. Next ligate all pulmonary veins except one and also the common brachiocephalic trunk. Cut transversely across the aorta about 8 to 10 cm. from its base. Repeat the experiment using the left side of the heart, with a venous tube in one pulmonary vein and an arterial tube in the aorta.

Pass a heavy probe or your finger through the anterior vena cava into the right atrium and on into the ventricle. Make a transverse slit in the atrial wall and observe its thin, smooth wall and the muscular ridges of the auricular appendix. Note the *interauricular septum* which completely separates the atria. Locate the spherical *atrio-ventricular opening* and place it under running water. Three flaps of a valve (the *tricuspid* or *right atrio-ventricular valve*) float up convexly into the atrium as soon as the ventricle is filled with water.



Mammalian Heart

a. Ventral view showing the use of venous and arterial tubes to illustrate circulation through the right side of the heart. A.L. Arterial Ligament; AO. Aorta; A.P. Auricular appendices; A.V.C. Anterior vena cava; A.T. Fat (adipose tissue); C.B.T. Common brachiocephalic trunk; C.V. Coronary vessels; H.V. Hemiazygos vein; L.A. Left auricle; L.V. Left ventricle; P.A. Pulmonary artery; P.V. Pulmonary veins; P.V.C. Posterior vena cava; R.A. Right auricle; R.V. Right ventricle.

b. Transverse section at level of base of ventricles. A.S.V. Aortic semilunar valves; L.A.V.V. Left atrio-ventricular valve (bicuspid or mitral); L.V. Left ventricle; P.S.V. Pulmonary semilunar valves; R.A.V.V. Right atrio-ventricular valve (tricuspid); R.V. Right ventricle.

c. Transverse section through mid region of ventricles. Endo. Endocardium; Epi. Epicardium; Myo. Myocardium; L.V. Left ventricle; R.V. Right ventricle.

When these flaps are brought into opposition they serve to separate the receiving atrium from the forwarding ventricle. Tendinous cords (*chordae tendineae*) attached to the margins of the valves at one end are anchored at the opposite end to finger-like muscular projections of the inner wall of the ventricle. These cords prevent the valves from reversing under the pressure of the contracting ventricle. Sever them and again place the atrio-ventricular orifice under the tap. The valve flaps now float into the atrium and are no longer competent. With a sharp scalpel cut between two of the valves flaps through the cardiac muscle to the apex of the ventricle. Observe the internal meshwork of muscles and the transverse *moderator band* extending from the *interventricular septum* to the lateral wall and serving to prevent over-distention of the chamber.

Expose the cavity of the left atrium in the same manner as the right. Note the two flaps of the *left atrio-ventricular valve* (*bicuspid, mitral valve*). Repeat the experiment for valvular action and incompetence. Small moderator bands are present rather than the single large one typical of the right side.

Make a transverse section across the pulmonary artery about 3 cm. above its base and pour water into it. Three cup shaped, crescentic, *semilunar valves* (Fig. b) close the aperture of the artery and prevent the water from passing into the ventricle. In life they prevent blood from regurgitating into the ventricle at the termination of the heart beat. Pin one or more of these valves to the arterial wall and repeat the experiment. The valve is now incompetent and water passes back into the ventricle. The structure and the function of the aortic semilunar valves may be illustrated in the same way.

Examine the heart wall noting its three composite layers, the *epicardium*, a fibrous outer coat, the thick muscular *myocardium*, and the smooth lining layer or *endocardium*. The valves are composed of double layers of endocardium. Make a transverse section across the ventricles about 3 to 4 inches from the apex. (Fig. c). Compare the thickness of the left ventricular well with that of the right. The heavy musculature of the former may be correlated with the extra work required in forcing blood to all parts of the body as compared to the lesser task of the right ventricle in pumping it to the lungs.

A Modern Biology Program for the High School

MELVIN A. HINTZ
South Milwaukee High School, South Milwaukee, Wisconsin

Today the biology course in the high school curriculum has largely replaced the traditional courses in botany and zoology. During the past fifty years biology has increased in prominence and is emerging as a vital high school subject. Biology should be included in the training of every educated person—not set apart to be taken by a few select students. Our progressive biology teachers

are heartily in favor of a program which will insure biology for every boy and girl.

Just as biology has in most schools, replaced botany and zoology as individual subjects, so also have the methods of teaching biology changed. Some schools list general biology in their curriculum, but on examination of the course of study there is revealed the fact that a number of weeks are devoted to the separate study of plant life, animal life, and human physiology. In schools where this is the case the only modern thing is the title of the course. In the great majority of high schools the study of biology is what the name implies, a study of living things. The subject matter is grouped around topics or problems such as: Health and Disease; Adaptations to Environment; Growth and Reproduction; Food Relationships; Improvement of Life; etc.; the aims being to instruct the boy and girl in the fundamental principles governing living things.

Plants and animals are associated together, for the most part, in nature, and it is quite logical that the boys and girls will observe this relationship. Why not teach them about living things from the point of view of this natural relationship and interdependence, rather than having them spend a number of weeks studying plant life; then having them "exposed" to a number of weeks of animal study; and finally finishing the course studying about man—especially physiological processes? Many conscientious teachers still follow the so-called, "biological trinity" course, but I am wondering if the boys and girls really enjoy their introduction to the science of life. The so-called "blended or correlated" course is favored by most teachers. It requires more adequate teacher training and also more work on the part of the teacher, but our boys and girls really enjoy their exploration of the living world—which more than compensates for the extra effort on the part of the teacher.

Biology should be, and in an increasing number of schools is, the most popular subject in the high school. It offers a pleasing and varied appeal to the average students' interest. It should not be called the course or subject where you have to cut up animals, hold snakes, etc. Where this is the case, the dissection has not functioned as intended. One often hears from students on visits to schools that all they do is observe "smelly" specimens, at least those that have been preserved in formaldehyde. Why not have living animals to replace the preserved ones for observation, at least the more common specimens studied? These criticisms are fair, but are they the cause of the biology course being unpopular? I believe that our trouble lies in the fact that the courses in the biological field are not within the range, interest, and ability of the boys and girls who either elect or are required to take the course.

To help solve this problem we can offer courses in biology adapted to the ability of the students who take them. In other words, we must, first of all, adjust the subject matter to meet the ability of the boys and girls rather than use "accepted" standards of attainment, or college entrance requirements.

Our high school enrollment figures have increased rapidly the past ten years and more boys and girls are taking or are required to take biology. The teacher in a school where biology is required has a real challenge. We have the students, and it is up to us to do something for these boys and girls. The progressive teacher knows that he cannot give the same work to the entire group and expect identical results. Biology teachers must meet this challenge,

face the facts, and above all MUST adjust their teaching to meet the varied needs of the boys and girls who joined the "party" for a "tour of the living world."

For the past nine years, in cooperation with the administration of our high school, we have been experimenting—I might say, pioneering—and have achieved results in a community where science, heretofore, has never been able to fulfill its true mission. Biology is a required subject, and no one can get a diploma unless he or she has passed a year's work in biology. We therefore get all the students in our school, good, fair, and poor. The I.Q.'s one year ranged from 63 to 132. Even though one does not have much faith in I.Q.'s it would not take a progressive teacher long to discover that there was a great variation in the abilities of this group of students. Naturally, those in the lower level cannot keep up with those of average or "superior" ability, and in far too many cases fail. Experience has borne out the fact that students dislike failure, and consequently we have a number who dislike biology, become discouraged, and often change their attitude toward school and life. Aside from the development of this undesirable attitude and the creation of problems of discipline, the most important aspect of the matter is that the boys and girls have not been given a fair chance to learn something of the science of living things. A modern biology program has, to a great extent, helped to solve this important problem.

Our students are divided into groups of more or less equal ability. The groups are selected on the basis of a weighted classification score, which takes into consideration, intelligence, school marks, teacher recommendations, social adjustment, and whatever else seems desirable.

In our school, this classification begins in the seventh grade, so that by the time the student reaches the sophomore year we can place him in a section with other students of somewhat similar abilities. We offer biology courses to fit the needs and abilities of the various groups of students. We do not tell the students which section they are in, but the nature, quality, and quantity of work depends on their classification. Each course is divided into minimum, median, and maximum assignments. At present we have a course for the "superior" or X group; another for the average or Y groups; and still another for the lower level or Z group. The latter we call Modified Biology.

The "Modified Class" presents a problem which is not easily solved. This being a new venture in the teaching of biology, there is little material available, and the teacher must supply the necessary tools. It was necessary to write a text, and to work out a plan of teaching which would help these students learn something of the science of life. Our present text was revised in 1935; it is in mimeograph form, bound, and consists of 168 pages. It is now being revised, with special attention being paid to the vocabulary which can be comprehended by the lower level students. The presentation of subject matter is more simple, the subject matter is couched in familiar terms, the illustrations are from life, and life and health are stressed. Methods of teaching too have been revised. Some of the handwork methods of bygone high school days are again being used; but nevertheless the students are finding biology interesting, and are learning something about the science of life which would probably have been denied them, without a modern biology program emphasizing the boy and the girl rather than the subject matter.

We are now offering courses in General Biology adapted for X and Y groups, Modified Biology for the Z group, and Advanced Biology as an elective for juniors or seniors. This gives us a balanced program for the natural sciences—one which has commanded the respect of the students who were required or elected to take them. Advanced Biology was the result of a request on the part of the students for more advanced work in the natural sciences, and we feel that now biology is really achieving its true mission in this community.

A Teaching Aid for the Demonstration of Yeast Fermentation

HAROLD M. KAPLAN
Middlesex University, Waltham, Massachusetts

I

There are several experimental methods available for the study of fermentation processes. Some of these are very complex, being useful particularly in physiological or industrial research. Others are neither sufficiently illustrative nor striking for demonstrating fermentation to a class of pupils or for motivating them to further their studies in this aspect of biology.

In the present paper, a simple apparatus is described which should be of value for demonstrating clearly to a group of biology pupils (1) the nature of the fermentation process, (2) a method to measure and compare fermentation rates, and (3) modifications of the time course of fermentation when a given chemical substance is added to the fermenting medium.

II

A section of the apparatus is illustrated in the accompanying figure.

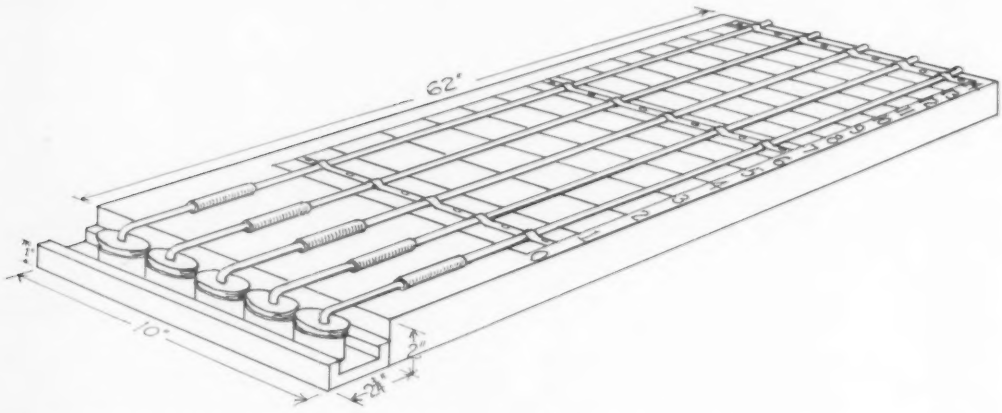
It was originally devised by the author in connection with certain research carried out at Harvard University a few years ago.[1]

[1] Unpublished data.

It consists of a series of fermentation vials, each capable of holding 8 c.c. of fluid (fermenting yeast cells suspended in aqueous solution). Each vial is closed with a tight fitting one-hole rubber stopper. A glass tube leads out, and by rubber pressure tubing connects each vial with a horizontal calibrated glass tube, 60 inches in length.

In the original apparatus, the writer has used twenty of these tubes, mounted parallel to each other on a board having the dimensions $62'' \times 24'' \times 2''$. The vials are held in a rack which is 24 inches long, $2\frac{3}{4}$ inches wide, and whose side walls are 1 inch in height. In the accompanying figure, less than one half of the total width of the apparatus has been drawn.

Before running any test, a large index drop of water is pipetted into each calibrated tube. The initial position of the index drop in each system is recorded after all connections have been made tight. The drops are then seen to be moved along with slow non-uniform velocity, due to the pressure of the CO_2 gas produced in the vials. Their positions (menisci) are recorded at successive equal intervals ($\frac{1}{2}$ to 1 hour) until the



fermentation has ceased. With the 3/16 inch bore glass tubing we have used, the index drops reach the terminal ends of the calibrated tubes only after 18 to 24 hours, and the speed of fermentation is clearly observed to be greatest during the first 3 to 5 hours.

It is apparent that the rates of fermentation are measured by determining the volume of the gas space over each fermenting sample, at constant pressure and room temperature—conditions which are alike for all the samples. Variations of temperature should be recorded with each reading.

Uncalibrated tubing may be used to reduce expense, the calibrations being made quite simply by holding each tube vertically, stoppering it below, and pouring down exactly 13.6 grams of mercury. Mark this as one cc. Keep adding such increments until the whole tube has been calibrated. The calibrations can be marked in equal subdivisions on a large sheet of underlying graph paper. Each tube must be calibrated individually.

Good material for this study is Baker's Yeast (*Saccharomyces cereviseae*). Pure strains grown in quantity under commercial conditions were originally obtained from the Fleischmann Company. Such cultures are undoubtedly available for laboratory experiments. The strain is essentially commercial baker's yeast but treated under such conditions as to exclude contaminants. It has been in use for many years in English breweries as a top-fermentation yeast. The stock yeast (it is compactly kept as pressed yeast) is preserved without spoiling at refrigerator temperature in an air-tight glass container.

Samples are prepared by suspending 5 grams of yeast in 100 cc. of distilled water (phosphate free), adding 5 grams of dextrose, and mixing thoroughly.

Into each vial 5 cc. of this uniform suspension are pipetted. If only the nature and rate of fermentation are being examined, the vials are directly stoppered and the experiment begun. All such tubes will then ferment at the same rates, within the limits of experimental error. In past experiments, these controls produced, without shaking, on the average about 5.1 cc. of gas during a period of 6 hours at room temperature. This will vary somewhat with the bore of the tubing used. The vessels contain a few cc. of air over the yeast suspension; the fermentation is thus not anaerobic until the oxygen in the air space as well as the dissolved oxygen has been used up. No corrections need be made for this or for dissolved CO_2.

Following this demonstration, the pupil can observe the effects of various stains, dyes, drugs, hormones, and other substances upon the yeast cells, and the resultant influence upon the degree of fermentation by the technic described below.

Five drops of a given stain in solution are added to a new sample, with shaking, and then the suspension permitted to ferment as above. It is well to use four or five vials for a given stain. This makes the test more certain since the results should not vary widely for any one set of vials, and the average can be recorded. Several of the tubes may be used as controls for comparison. The method permits the determination of the effects of several unlike stains in one run, since at least 20 vials can be lined up side by side without making the apparatus too cumbersome.

If the instructor wishes to make the test quantitative, the average performance of 5 to 10 controls run under identical conditions is marked 100 per cent; the average performance of the stained or drug-treated samples in producing gas is then expressed as a per cent fraction of the control.

III

The foregoing makes a clear series of demonstrations which may be further expanded into project work. The pupil may be asked to consider the chemistry of the fermentation process, or the various applications of knowledge in this field. There is still an unlimited number of research problems in this field.

The effects of many drugs upon living cells may be demonstrated with this apparatus. For example, chloretone, which is a narcotic drug, is found to decrease fermentation, and the depression is proportional to its increasing concentrations. Injuries to the cells can be visually determined by examining a drop of the suspension under the high power of the microscope, after the run is completed.

The apparatus may be very useful for the investigation of the effects of hormones upon cellular processes. The writer has incompletely investigated the effects only of adrenaline (Parke Davis) by this method. All concentrations of the hormone initially raise yeast activity. Highly concentrated fractions, however, produce a depression of activity, more quickly and more profoundly. Obviously, much of interest awaits investigation.

TEACHING BIOLOGY BY THE PROJECT METHOD

For about ten years the pupils of Pittsburg High School have been pursuing projects as part of their regular biology work. In order to qualify for a grade of "A" or of "B" a pupil must satisfactorily pursue a project to completion. No one is failed simply because he does not pursue a project. However, the student does not qualify for any grade above a "C" which is the average grade in this school, should he not choose to work on a project.

At the beginning of the school year, teachers explain to their respective classes, that since no note-book or work-book is required, that they will be expected to spend an average of an hour a week on their project. This means approximately 18 hours per semester. The students are urged to take "hiking" as their chief activity, hoping to take the students into the field, to "follow up" regular class and textbook work. Usually, boys see that live water specimens, such as frogs, crayfish, snakes, turtles and fish are constantly in the laboratory when the particular subjects come up for study. Thus a constant supply of fresh material is at hand when needed.

A few students are used on the library "repair" and "catalogue" groups. The duties of these groups are two-fold, (1) to keep the reference books of the biology library repaired and, (2) to keep the card index up to date with references concerning nature, as taken from, "Nature Magazine," "Hygeia," "Bird Lore," and other references in the classroom. In pursuing such work, many are incited to read more articles. The students work in shifts, two coming at least twice a week. They may put whatever time they desire into the work, keeping account of their own time and work. Other students are kept busy balancing aquaria, feeding fish and other animals, painting cages, repairing vivaria, making leaf and insect wall displays, etc. Quite a number of students choose stretching and mounting of insects for projects. Others are interested in making posters of birds for wall displays.

This year, one boy is removing the flesh from a rabbit, in an attempt to mount a skeleton. He is learning interesting things about anatomy and is kept busy looking up bits of information in reference books and supply catalogues, showing displays of skeletons. Three boys are attempting to collect and preserve various kinds of fish, snakes, turtles, and frogs to supplement our present inadequate display of specimens in glass jar receptacles.

Should pupils take "bird observation hikes" as a project for credit, they are required to note the main colors of birds, approximately the size in inches (using English sparrow, robin and crow as measuring sticks), and if possible, where they found the bird. Some even observe weather conditions and the temperature. With very brief notes, they come in to "chat" about their hikes, shortly after making them. They may go in friendly groups of a few members each, all getting the same credit, which is the actual time of the entire hike.

Perhaps one may wonder how the "checking up" is done on such a varied scheme of project work. At the beginning of each school year, each student is handed an accumulative "Project Report Sheet" on which he keeps an accumulative account of his various activities. He is asked to pursue not more than one or two different activities at the same time. Yet anytime he brings anything into the laboratory of a display or useful nature, he is given credit. Each two weeks, the teacher calls for these sheets, checks the items listed, calling the pupil up to his desk for information about his records. In this school, one day a week is used as a supervised study period in biology, at which time, the students are consulted concerning their progress or results. This scheme avoids much "after-school" work. Once the class is properly organized, this checking is not so difficult as it might appear. Since the entries and all accounting are made by the student himself, the time spent on similar items with different students, differs considerably from time to time. In the case of gardening, the raising of animals or caring for such at home, the teacher visits these students at least once in their homes, to observe their work there. This tends to produce a more friendly atmosphere and better cooperation between the school and the home.

Claude I. Huffman
and Dora Peterson,
Senior High School,
Pittsburg, Kansas

TO OUR MEMBERS

You can assist in improving the journal by renewing your membership promptly.

HUMAN INTEREST IN HIGH SCHOOL BIOLOGY

In his book *The Story of Biology,* Dr. W. A. Locy says that "the story of how human interest in plants and animals started and developed is essential to comprehending the service of biology to human progress."

Every biology department has its own favored method of helping students "to best understand those things which we know in their origins." Several years ago our department worked out a plan to include a certain amount of the background of biology. We reasoned that scientific attitudes might best be understood by studying the lives of outstanding scientists.

It was decided that a student would appreciate the course more if he knew something about the individuals who have, in their own way, contributed to the known facts of to-day. Knowing that the average high school sophomore is more interested in persons living than persons dead, the project had its beginning by first compiling a list of living men and women who are contributing something to present day biology.

Each student was permitted to choose a scientist whose work seemed, to his own interest, most appealing. Thus began the individual research problem. Each student was encouraged to find as much material as possible in the biographical study of his chosen scientist. Source material in both school and city libraries was investigated and records made of materials available.

At the close of the research period each student gave a brief oral report on his findings to his class and submitted a short outline to his instructor.

Reference lists were prepared in a card file and made available for future students. New references have been added yearly and to-day the file is quite complete.

Several students expressed a desire to write to their chosen scientist for an autographed photograph which, when received, would have a permanent place in the laboratory. The idea met with success.

During the next few years more photographs were added to the growing collection. Pictures of biologists of the past several centuries were purchased to make the collection more complete. To-day there are twenty-six pictures on display in the laboratory.

A certain supply house of biological equipment is to-day offering a very inclusive list of subjects from which to select pictures to serve as teaching aids. Recent issues of magazines, such as *Natural History,* contain authentic biographies of active biologists.

Since the inception of our departmental project, we feel that the students are realizing more and more that the biological facts known to-day have been obtained only after much hard work.

JOSEPH B. SOMMER,
Peoria High School,
Peoria, Illinois

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Notes and News

MEMBERS IN THE CLEVELAND AREA are urged to attend the joint meeting of the Greater Cleveland Biology Society and the Biology Section of the Central Association of Science and Mathematics Teachers to be held in Cleveland, Ohio, on November 22 and 23, at the Hollenden Hotel. An interesting program is assured. The meetings are open to all our members.

MR. P. K. HOUDEK, SECRETARY-TREASURER of *The National Association of Biology Teachers*, spoke before the Biology Section of the Central Ohio State Teachers Association in Columbus, Ohio, November 1, on the subject, "Introducing Sex Education into High Schools."

BACK NUMBERS OF VOLUME II OF THE AMERICAN BIOLOGY TEACHER are available at 15 cents each, remittance with order. Write to the Secretary-Treasurer.

THE NEW HAMPSHIRE ASSOCIATION OF BIOLOGY TEACHERS was organized on September 21, 1940, in the biology room of Concord High School in Concord, New Hampshire, by members of *The National Association of Biology Teachers*. Officers elected are:

President: Fletcher J. Proctor of Concord High School, Concord, N. H.

Vice-President: Samuel J. O'Neil of Manchester Central High School, Manchester, N. H.

Secretary-Treasurer: Cynthia T. Corson of Dover High School, Dover, N. H.

Directors: Guy F. Williams of Colby Junior College, New London, N. H., and Harold Currier of Portsmouth High School, Portsmouth, N. H.

The members enjoyed examining and discussing the many interesting projects done by Mr. Proctor's students. A discussion was held on local problems in biology teaching and the part an organization might play in furthering the study of biology in the state.

The next meeting of the organization is to be held on Saturday, December 7, 1940, at 10 A.M. in the biology room of Manchester Central High School in Manchester, N. H. Any biology teacher in the state who is interested is cordially invited to attend and become a member.

THE KANSAS ASSOCIATION OF BIOLOGY TEACHERS held its annual meeting in Wichita on November 1, 1940. The program follows:

Business Meeting.
Dr. J. A. Trent, President, presiding.
Greetings from the National Association.
Homer A. Stephens, President-elect of *The National Association of Biology Teachers*.
Report of the National Meeting.
Dr. John Breukelman, President-elect of the Kansas Association.
Report of the Secretary-Treasurer.
Miss Gladys Beck, Kansas City.
Report of Nominating Committee and election of officers for 1940–41.
Discussion Program.
Dr. Breukelman, presiding.
Discussion: "The Problem Approach to Biology."
Miss Ella Thea Smith, author of "Exploring Biology," Salem, Ohio.

ACCORDING TO *Science*, THE U. S. FOREST SERVICE has set aside 4,131 acres of essentially virgin hemlock-beech forest in northwestern Pennsylvania, to be devoted permanently to scientific use and to the education and recreation of the public. This tract, located seven miles south of Ludlow, is said to be unique in that it contains the largest area of primeval forest of its type in the east and is also the largest single body of virgin timber between the Adirondacks and the Great Smokies.

The area is divided into two parts: the northern portion, named the Tionesta Scenic Area, containing 2,018 acres, will be open to the public by road and foot trails; the southern part, consisting of 2,113 acres and designed as the Tionesta Natural Area, is dedicated primarily to scientific research. The natural area is open to all interested scientists for use in investigation of such problems as forest and animal ecology. Those who are interested may secure further information by writing to the Allegheny Forest Experiment Station, Philadelphia.

NEW ASSOCIATE EDITORS ELECTED

We take great pleasure in announcing the election by the Executive Board of four new associate editors residing in geographical regions not heretofore represented on the editorial staff. All of these persons, whose names are listed below, teach biology in high schools.

Mr. W. A. Betts, B.A. and M.A., The University of Texas; University High School, Austin, Texas.

Mrs. Helen Connon, B.A. and M.A., The University of California at Los Angeles; David Starr Jordan Junior High School, Palo Alto, California.

Mr. Richard F. Trump, B.S., Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa; Keokuk Senior High School, Keokuk, Iowa.

Mr. Lee R. Yothers, B.S., University of Pittsburgh, and M.A., Columbia University; Rahway High School, Rahway, New Jersey.

All four have had experience in writing for publication and are ready and anxious to give advice and assistance to contributors of manuscripts.

TEACHER TENURE

I wonder whether you would be willing to help by inserting an item in THE AMERICAN BIOLOGY TEACHER asking that anyone elsewhere in the country who has information bearing on the questions below communicate with me. I am afraid that the first question may soon become vitally important to the biology teachers of New York City.

1. What provision is made for teachers who are in excess as the result of a change in curriculum decided on by a local board of education, or made necessary by changing conditions?
2. What provision is made for the relicensing of teachers if the subject previously taught is dropped from the curriculum entirely?
3. Assuming that a subject previously taught in the senior high school is shifted down to the junior high school, which is on a lower salary schedule, how is the teacher's salary protected?

PHILIP GOLDSTEIN,
Walton High School,
The Bronx, New York City

CORRECTION

In the article, "An air tight balanced aquarium," in the October, 1940 number, page 26, it should have been stated that the formula for artificial pond water used in culturing Protozoa was one used by Brandwein et al in the manual for the "Laboratory Techniques in Biology" in-service course.

EXCHANGE

Members who wish to exchange with other members materials for use in teaching or research are asked to send the editor lists of their wants and of the material available for trade. Such lists—which should include only two or three items—will be published without charge.

An Interest Survey in Biology

J. W. GALBREATH
Senior High School, East St. Louis, Illinois

Several investigators have attempted to ascertain the role that pupil interests should play in determining the subject matter that should be included in a course of study.

Writers of textbooks, publishers, and students of methods have long played up the interest value of their textbooks and subjects.

Thus Craig states, "any program for the elementary school must give consideration to the interests and experiences of children." We could find a duplicate of this idea in any course of study or textbook we might care to examine.

Briggs recommended that discovery, creation, direction, and strengthening of "interests" was of primary importance in presenting and developing subject matter.

Hullfish writing in 1933 under the editorial leadership of Kilpatrick says ". . . These emphases throw into relief the fact that education must move forward from the interests of the individual."

There has been some confusion as to what constitutes interest. Webster defines "interests" as "Excitement of feeling, whether pleasant or painful, accompanying special attention to some object; concern. . . ."

The "New Standard Dictionary" defines interest as "personal concern, lively sympathy . . . a sense of concern." Other writers have defined interest as a symptom, indicating pleasure in the activity and relief from some irritant. Thus we see that interest is difficult to define and it is little wonder that the term is used loosely and often with much misgiving.

What has often been termed interest unquestionably has often meant curiosity.

Fitzpatrick states that survey of interests in the past have not agreed in their results, and expresses the need for further investigations in this direction.

In investigations directed by Hunter, part of his conclusion was that students know most about those topics they reported the greatest interest in. Fitzpatrick concludes in his studies that interests are more or less transient, unstable or undependable, or both, and that this is true from the fifth grade of the elementary school to the graduate college student. He further states that "interests" should not be the sole factor in determining subject matter in a given course of study.

It seems to the writer that much of what we have called "interests" in science surveys is only curiosity. We have an inborn tendency to be curious about the unknown, but through true interest, that in which we are concerned and which engages our feelings or emotions comes only from knowledge.

Thus a monkey may be curious about a tricycle, a bird curious about a bird box, a boy is curious about a new toy. When the monkey learns to ride the tricycle he has gained genuine interest in it. When the bird builds its nest in the box it has an interest there. When the small boy learns to play his new game or to play with the new toy he has developed interest. If knowledge is gained concerning that about which we are curious we have developed an interest.

Interest is acquired; curiosity is an instinct and thus inherited. Man was instinctively curious about fire; he burned his fingers; he had acquired an experience which enriched his knowledge: fire was hot; it must be respected. Later, through further curiosity, he learned to use it to cook his food and heat his cave. He became genuinely interested in fire as one of his best friends.

Thus curiosity may be a driving force to get an education or to learn about certain natural phenomena and interest is acquired as we gain this knowledge. Curiosity may be the beginning of many interests which may or may not be permanent. Curiosity shifts with age, time and sex.

A subject or topic may often excite the curiosity of an individual until he has gained a little knowledge about the subject; his interest then may cease. Added knowledge may be the only way to increase interest but when knowledge is gained he sometimes finds no immediate usefulness in it in pursuit of his larger main interests—his life philosophy. Interest then dies and he is no longer even curious.

Boys or girls may think they are interested in the microscope when they are only curious, not understanding its use or value. After using a microscope for three or four weeks this curiosity may have deepened, and a genuine interest may have developed concerning its use and value as a means to an end in biology—or there may have appeared genuine disgust with it.

Interest may carry a student on to do research work which requires the constant use of the microscope. In that case much interest has developed as knowledge was gained; the two are inseparable —the more knowledge the more interest.

With the results of Fitzpatrick and others in mind, the writer carried on the study described below over a period of two years, in his tenth grade biology classes. A survey was made covering nine classes of beginning biology students or 255 students, and eight classes or 200 students who were completing the course. The 200 students completing the course were not all the same individuals who took the survey at the beginning of the year.

Each student was given a mimeographed sheet containing a list of topics covered in the year's course in biology, with instructions for marking his first ten choices. A copy of the sheet follows:

Select the ten topics you are most interested in from the following list. Write on your paper the numbers 1 to 10; after No. 1 write your first choice, after No. 2 your second choice, etc., until you have ten choices. Select topics that you would like most to study in biology. If you have other subjects that you would like to study you may include them in your selections. Write *number of topic* not topics themselves.

1. Cells.
2. Microscopic Study.
3. Life processes, digestion, circulation, etc.
4. Reproduction.
5. Classification: Plant phyla and Animal phyla.
6. Distribution of plants and animals.
7. Growth.
8. Interdependence of Plants and Animals.
9. Adaptations.
10. Behavior.
11. Photosynthesis.
12. Evolution.
13. Heredity.
14. Health Principles.
15. Fossils.
16. Economic importance of plants and animals.
17. Environment.
18. Great scientists.
19. Vocational biology.
20. Disease and disease germs, bacteria.

21. Conservation of natural resources. Wild life.
22. Eugenics.
23. Euthenics.
24. Leisure time biology (state what).
25. Common birds, trees, and flowers.
26. Sex education and social hygiene.
27. Hobbies in biology.
28. Working on biology projects.
29. Reading and reporting books of biological interest.
30. First Aid.
31. Structures of human body.
32. Safety education.
33. Add any other subject or topic you are interested in and think you should be taught in biology.

The answers were scored by recording the total number of times each topic was chosen; for example, 175 students out of the 255 marked "microscopic study" in their first ten selections.

In the accompanying table the topics are listed in the order of their frequency at the beginning of the course, all topics which did not score a total of 30 or more being omitted. These same topics are scored and ranked in column two. In each column the rank given is that secured in the total list of the 32 topics as given in the survey.

TABLE SHOWING INTEREST RANK ASSIGNED TO TOPICS IN BIOLOGY BY STUDENTS AT THE END OF ONE MONTH AS COMPARED WITH THE END OF THE YEAR

	End first month's study of biology		End year's study of biology	
	Rank	No. of students	Rank	No. of students
Microscopic study	1	175	3	116
First aid	2	169	2	124
Common birds, trees and flowers	3	159	12	67
Structure of the human body	4	145	7	90
Growth	5	129	4	98
Fossils	6	119	8	87
Safety education	7	117	13	66
Conservation of natural resources	8	115	10	70
Hobbies in biology	9	113	15	53
Disease and disease germs	10	111	5	94
Health principles	11	101	11	69
Environment	12	97	7	90
Great scientists	13	78	19	34
Sex education and social hygiene	14	76	10	70
Behavior	15	70	6	91
Adaptations	16	69	16	51
Life processes	17	64	14	60
Heredity	18	63	1	127
Economic importance of plants and animals	19	62	22	26
Reproduction	20	54	9	72
Cells	20	54	21	27
Distribution	21	51	25	17
Work on biology projects	22	48	20	33
Interdependence of plants and animals	23	40	24	20
Vocational biology	24	35	27	13
Classification	25	34	17	50
Evolution	26	30	18	45

INTERPRETATION OF TABLE

Column one includes the twenty-seven highest-ranking topics, as marked by the beginning students.

Column two gives the final ranking and the number of students on the same topics as ranked in column one.

After a study of the ranking is made we find that microscopic study and first aid were of first interest to beginning students in biology; heredity ranked number 18. Heredity, however, ranked first to the students who had recently studied a unit on heredity. The first unit included microscopic study and cells, the ninth and last of the course included first aid. Since, as other writers have pointed out, recency of subject matter plays an important part in the ranking given by students, microscopic study, which was studied first and heredity, which was studied near the end of the course, probably benefited from this factor, as shown in columns one and two, respectively. Microscopic study, however, had dropped only to third place at the end of the semester.

It is also interesting to note the similarity in ranking in columns one and two for several other topics. For

example, first aid, growth, fossils, cells, biology projects, conservation, health, and adaptation do not vary over two places in columns one and two. Another interesting point to consider is that pupils who expressed an interest in health often neglected to mark an interest in disease or disease germs. The relationships between these topics were not recognized.

General Conclusions

1. Confusion has resulted in "interests" surveys due to a lack of understanding as to what constituted interest.
2. Interests are unstable and therefore unreliable as a single guide for determining subject matter included in courses of study.
3. What has often been termed interest in the past has been mere curiosity.
4. Interest is acquired or lost as knowledge is gained.

Bibliography

1. Briggs, Thomas H. "Secondary Education." Macmillan, 1934.
2. Craig, Gerald S. "A New Science Program for Elementary Schools." 1934.
3. Fitzpatrick, Frederick L. "Science Interests." Columbia University, 1936.
4. Hunter, George W. "Science Teaching." American Book Co., 1934.
5. Kilpatrick, W. H. "The Educational Frontier." D. Appleton-Century Co., 1933.

WORK WITH BUFFER SALTS

The Concept.—The carbon dioxide, which is continually added to the blood by the body cells, is a continually increasing source of acid—carbonic acid. Digested foods, such as fatty acids and amino acids, also pass into the blood stream. Yet the acidity of the blood is known not to rise. Since, also, the blood is known not to be continually supplied with alkaline material, whence comes this neutralizing agent? The answer lies in the action of the *buffer salts* found in the blood. It is the action of such salts that the following demonstration illustrates. In the blood the buffer salts consist of the acid carbonates and phosphates.

Demonstration.—Several solutions are prepared in which various salts have been dissolved. To some of these are added measured amounts of base, to others acid. An indicator is used to show when the acidity or alkalinity has risen sufficiently in each solution to effect a change. All the acid solutions are brought to the same color; so also are the basic solutions. It then follows that the same degree of acidity or alkalinity prevails in each group; any variation in the amounts of base or acid used must be due to the resistant action of the salts present.

Any number of methods could be used to show this action. The following arrangement has been found to be simple and effective.

The Set: There are five groups, each consisting of 3 vessels (100 cc. beakers, or collecting bottles). In each of these vessels there is poured 25 cc. of indicator. The indicator used is anthocyanin, obtained by boiling several red cabbage leaves in 500 cc. of water.

Water only is added to the vessels of the first group. To each vessel of the other four groups various salt solutions are added, as shown below.

Group 1. (Control) 50 cc. of water.

Group 2. 50 cc. of a solution made by dissolving one teaspoon of $NaHCO_3$ in 200 cc. of water.

Group 3. 50 cc. of a solution made by dissolving one half teaspoon of KH_2PO_4 in 200 cc. of water and one half teaspoon of Na_2HPO_4 in 200 cc. of water.

Group 4. 50 cc. of a solution made by dissolving one teaspoon of KH_2PO_4 in

200 cc. of water.

Group 5. 50 cc. of a solution made by dissolving one teaspoon of Na_2HPO_4 in 200 cc. of water.

The indicator is blue in neutral solution; first purple, and then red, as more acid is added; and green when the solution is made basic. If a great deal of base is added it turns yellow.

A supply of acid is prepared by diluting concentrated HCl to one half. Concentrated NH_4OH, diluted to one half, is used for the base. Any device for producing drops may be used with these —open beakers with eyedroppers or pipettes, or burettes, into which the solutions are poured.

The Action: In each group, to one beaker a few drops of acid is added; to a second a few drops of base is added; the third is left unchanged as a control. An arbitrary amount of acid and base is added to group one to establish a basis for comparison.

Group 1. Two drops of acid : the liquid turns red
Two drops of base : the liquid turns green

With just the water, only two drops of the acid or base are needed to effect this change.

Acid is now added drop by drop in one beaker in each of the other groups, until the color of the liquid in these beakers matches the red color obtained in this first group with only two drops of the acid. Then in a second beaker, in each group, base is added drop by drop until these match the green obtained in group one.

Results: The number of drops needed to produce a matching of the colors.

	Base	Acid
Group 2	0	40
Group 3	14	10
Group 4	30	4
Group 5	0	15

Of course these numbers will vary some, but they indicate the relative amounts each of these salts will resist. The potassium salts used in Groups 3 and 4 are found in the blood. It is by the reaction here illustrated, that the acids, which at times enter the blood, are neutralized.

N. Eldred Bingham and
Eric Drew,
Columbia University

PHOTOMICROGRAPHY WITHOUT A MICROSCOPE OR CAMERA

In biological photomicrography it is frequently desirable to photograph not merely a tiny section of the tissue, but the entire piece of tissue on a slide. By removing the lower portion of the low-power nose-piece, the field may be increased to some extent, but in order to enlarge a piece of tissue, say 20 mm. in diameter, it is impossible to do so with a microscope. The accompanying illustration of a mid-sagittal section of a 20 mm. embryonic mouse was made in the following manner. The microscope slide was placed in an Elwood enlarger and projected onto a piece of Eastman contrast lantern slide sensitized glass. This slide when developed was equivalent to a $3\frac{1}{2} \times 4$ inch negative. By using this lantern slide glass in the enlarger, prints up to 18 inches in length were made.

The following gross structures can readily be pointed out on the finished picture: teeth, tongue, nasal sinuses, lobes of the brain, spinal cord, backbone, ribs, pelvic girdle, trachea, lungs, heart, liver, kidney, and intestines.

No filter was necessary because the microscope slide was stained with a combination of Delafield's Haematoxylin,

and Mallory's stains,—a combination devised by Dr. George J. Brilmyer, M.D., of Washington, D. C. By using this stain the general color of the slide is a purple, and contains no light blue, which would photograph almost white, nor any dark red, which would photograph almost black without the use of filters or panchromatic film.

Rev. John W. Baechle,
St. Joseph's College,
Collegeville, Indiana

Books

Baker, A. C. and Mills, L. H. *Dynamic Biology.* Rand McNally & Co. 732 pp. 1938. $1.35.

Mechanical Make Up: The text is constructed so as to promise durability. The pages are fastened securely, yet the binding is flexible enough to withstand improper usage. The cover is of a durable, pebbled finished fabric which tests show to be waterproof. The cover design is appropriate and attractive, the color scheme is distinctive. Black and white illustrations are clear, though the colored engravings lack distinction.

The type is chosen to emphasize features of organization. Small black type of exceptional clearness is used to accompany illustrations. Glossary entries are notably clear. Italics are used freely to introduce technical terms. Footnotes are small but distinct.

The drawings and photographs, taken from extensive sources, are appropriate and profuse. The drawings are capably executed. The cost is comparable to other books of its class. The activity book is the consumable type, its pages secured by wire staples, and provided with a sturdy paper cover.

Literary Style: The title *Dynamic Biology* accurately expressed the general trend of the entire book. It pulsates with life from start to finish, and the "ugly worm changing to a beautiful butterfly," or "such emotions as fear, panic and grief, hatred and rage are unfavorable to health and consequently should be avoided," leave some tangible idea of how intricate and far reaching are the problems of life.

The style is generally modern, in that short sentences are used. As a result the

material presented is very clear and concise, but in some instances shows the inevitable result of breaking up ideas rather than clarifying thinking by interrelating these ideas.

The words are uniformly well chosen, but now and then a word appears that makes one wonder as to its use; for example, the word replenish referring to reproduction. Further it is doubtful if the use of the personal "we" is necessary to sustain interest, rather it would seem to be talking down to the student.

"The digestive tract of the living machine" functioning like the "carburetor of an engine," "microbe detector a Sherlock Holmes," are a few examples of how new ideas are closely correlated with other subject matter.

The narrative style as shown in "Dan Eisler and his Microscope" is extremely good throughout, while the exposition itself could be more challenging.

Learning Exercises and Teacher Helps: The text features a profuse series of teacher aids summating each unit. Thorough lists of charts, visual aids, and bibliography indicating specific reading assignments are distinctive features. In the superb execution of the line cuts, in the excellence and balance of the typography, and in the outlined objectives preliminary to each unit one finds additional teacher aids. Laboratory exercises might receive greater emphasis.

Psychological Soundness: The text begins as an economic and civic biology and changes to phylogenetic exposition, then to a discussion of nature trails and back to civic biology. Microorganisms are discussed in Unit II and also in VII and IX. The sub-topics of the many units are stated in a stimulating problem form, but are not in all cases followed through by problem development. Units vary from 14 to 108 pages. Neither psychological nor seasonal sequence can be observed. A question might be raised as to the difficulty of parts of Unit III, IV, and VII for even brighter pupils in a ninth year grade. The workbook has about a thousand fill-in spaces and no more than 10% encourages use of the scientific method of thinking. More consideration might be given to individual differences.

Subject Matter: The units are planned to appeal to pupils' own experiences and interests. Direct suggestions are: indoor and outdoor field trips, experiments, collections, demonstrations, committee projects, readings, special reports, maps and posters.

Only trivial factual errors appear; some are a matter of opinion. Page 66 omits the inventor(?) of the microscope; page 131 does not explain how sterile agar is transferred from flasks to Petri dishes; Noguchi is credited with identifying the yellow fever parasite, a consideration which he himself later doubted.

Every generally accepted essential topic and fundamental generalization is covered by the 14 units: 1, adaptation and variety of life forms; 2, cell theory and microorganisms; 3, germs and diseases; 4, health; 5, insects; 6, physiology and anatomy; 7, taxonomy; 8, nature study; 9, interdependence; 10, behavior and nervous control; 11, reproduction; 12, embryology and growth; 13, heredity, eugenics, and euthenics; 14, evolution.

Some new words are defined when first used, others in footnotes: some are not in the 550 word glossary, which has a key to pronunciation. Taxonomy is summarized in the appendix.

Alan A. Nathans (Chairman)
George B. Salmons (New York State)
Anne L. Bigler (California)
L. J. Gier (North Carolina)
Alva Z. Allen (New Hampshire)

SEARS, PAUL B. *Life and Environment.* Bureau of Publications, Teachers College, Columbia University, 1939. 175 pp. $1.85.

"Ecology" is a word to conjure with; so are "integration" and "core subjects." Professor Sears, an ecologist, finds that the study of biology from the viewpoint of "life in relation to the environment" would serve admirably as the core around which the "subjects" of the curriculum could be built. It seems that if we wish our students to live satisfactorily on this earth, there is no better way than to show them life as it really exists in the varied environments of this planet called earth.

Professor Sears, briefly but competently, discusses the laws of Nature as they apply to human environment and life in general. The reader is acquainted with the interrelationships of the lithosphere, hydrosphere, atmosphere and biosphere. Much is made of the necessity of maintaining an equilibrium in order that our days may be "lengthened" upon the earth.

There is profound faith here in the science of ecology and its potentialities for the solving of human problems. On page 11, the Professor says, "It is important to know these laws (which cover the general relationships of life and environment) so that man may understand the world and make it a suitable abode for himself." But Professor Sears is not concerned with the physical abode alone. His ecology is not limited; environment is neither completely physical nor is it static. It includes culture; it is definitely dynamic. On page 97, he asserts:

> . . . the profound cultural regression of the Western world today has some of its roots in the violent lowering of ecological potential caused by the destruction and disorganization inherent in war itself.

and on pages 99–100:

> It is to his (man's) interest to promote through his culture a pattern of relationships which, like the climax community, represents as effective as possible a means of conversion of energy materials for his use. This is one of the great problems of modern civilization, and is vastly complicated.

or

> . . . man has the means of working toward a new type of equilibrium, frankly controlled for the permanent welfare of himself, now the dominant organism.

The end of all this ecology is, of course, a better society. The scientific principles established by technical investigators can provide the materials for bettering the conditions of society. An adequate study of the interrelationships of life and environment and their effects upon each other for constant alteration will lead to the improvement of society. To Professor Sears, "the most essential social function of ecology is to remind civilization of the physical basis upon which it rests" (p. 135).

This reviewer, somewhat bewildered (to put it mildly) by the present chaotic state of society, is not so sure of Professor Sears's analysis. He is not sure that a more accurate study of the physical basis of society will provide the solution to the social puzzle. In any case, ecology should rightly include the science of semantics to make more concrete such terms as "ecological potential," "climax community," "equilibrium," which occur throughout the book in profusion.

From an educational standpoint, *Life and Environment* attempts to present a point of view for the curriculum worker and the layman interested in educational problems. It is the first of a series of basic science materials being prepared by the Bureau of Educational Research in

Science of Columbia University. In an extended appendix, Professor Sears discusses the pedagogic implications of his work. The need for studying the immediate environment is stressed but no attempt is made to indicate definite curricular materials. The book is intended to give a point of view, a philosophy—on the basis of which specialists in biology, physics, chemistry, sociology will cooperate to present a more integrated course of study on the secondary school and junior college level.

The general outlook inherent in this book has probably already had some influence in the making of new general science courses now being offered in high schools and in survey courses given in colleges. How many of the interrelationships mentioned by Professor Sears can be made intelligible to the high school student remains to be worked out by the curriculum worker. How much of the sociological can be combined with the "physical and biological sciences" is also a problem for the curriculum worker. Whether their integration into the "subject" called "Ecology" is the method by which to reach Utopia is, to say the least, open to debate.

B. Leibson,
Christopher Columbus High School,
New York City

Stuart, Richard R. *The Anatomy of Necturus.* 25 pp. *The Anatomy of the Cat.* 28 pp. Denoyer-Geppert Company, Chicago, 1940. Each booklet 50 cents.

These two booklets contain drawings which are intended to supplement the existing texts and manuals. The drawings are of an excellent grade and are fully labeled.

I doubt whether the drawings of the muscular and circulatory systems facilitate laboratory work. I believe they tend to convey a false impression of over-simplicity and thus confuse the student rather than aid him.

Presenting the student with a complete set of labeled drawings in many instances encourages the student to disregard the laboratory directions and lean heavily on the drawings. When this occurs much of the educational value of laboratory work is lost. I do not believe that it is desirable to place a set of drawings in the hands of students in such a highly specialized course as comparative vertebrate anatomy and a fairly complete set of fully labeled drawings such as is represented in these two booklets even less desirable.

John P. Wessel,
Wright Junior College,
Chicago, Illinois

Sex and Life. Eugen Steinach.

The author's experimental work on the activities of the sex glands has in the past attracted much attention, and has led to the publication of many unscientific and exaggerated stories concerning his achievements. This autobiography is a factual, scientific description of carefully planned experiments and their results and applications. Viking Press. 1940. 252 pages. $3.75

The World Under the Sea. B. W. Smith.

This book is divided into two main sections. The first describes Oceanography, the Science of the Sea. Here are discussed such topics as: Our knowledge of the Ocean, Submarine Earthquakes and Volcanoes, Currents and Tides and the Physics of the Sea. The second section contains vivid descriptions of the many varieties of life within the sea and the eternal struggle for existence that goes on there. D. Appleton-Century Co. 1940. 219 pages. $3.00

Alexander A. Fried

Biological Briefs

RUTH SHERMAN

WENT, F. W. *Local Reactions in Plants.* American Naturalist 74: 107–116. March–April, 1940.

The reactions of plants to parasitic injuries occur in wide variety, depending upon the nature of the host and of the parasite. Some plant parasites release toxins which destroy cell walls, allowing the contents thus liberated to serve as food. If the cells surrounding the injury can function quickly enough, a cork layer walling off the infected tissue and the parasite is built up. This is apparently aided by the stimulating effect of growth-promoting "wound hormones" liberated by the injured cells. Where parasites must depend on living cells, as in the case of rusts, the invaded cells of a resistant plant die, thereby killing the parasite and forming the characteristic discolored areas. Where invasion by parasites causes the formation of atypical growths, these may develop only if the possibility for such growths is inherent in the host plant; such responses are often accidental and not useful. For example, a growth hormone injected into willow leaves by a gall wasp at the time of oviposition initiates the development of the gall.

PUMPHREY, R. J. *Hearing in Insects.* Biological Reviews 15: 107–131. January, 1940.

Among insects, tympanic organs are the most common type of hearing organ; they are found in the Orthoptera, Hemiptera, and Lepidoptera. Many of these insects have been shown to possess some ability to distinguish between different sound frequencies, and some can also localize sound. Some insects which do not possess tympanic organs receive sound by means of hair sensilla; the hairs on *Vanessa* caterpillars function in this way, as do also the anal cerci of crickets, cockroaches, and locusts. It is possible that ants use their antennae to detect sound.

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SNYDER, R. GARFIELD. *Arthritis—a Neglected Disease.* Annals of Internal Medicine 13: 1317–1326. February, 1940.

Ranking first in prevalence among chronic diseases and disabling nearly seven million of our citizens, rheumatism is an ever-present challenge to medical skill. Almost half of these afflicted persons have arthritis. At least 75% of all arthritis cases may be materially improved or cured if properly diagnosed and treated within the first year of incidence. Many laymen neglect such early symptoms as muscular pains, lassitude, and stiffening joints, and then seek aid from quacks, patent medicines, or home diathermy. The incidence of this disease is 50% higher among the poor than among the wealthy; yet few funds are available to help the needy thus afflicted. Likewise, facilities for graduate study and medical research in this field are lacking. We must recognize that this problem, as in the case of tuberculosis and infantile paralysis, must be met by the combined forces of medical and social agencies.

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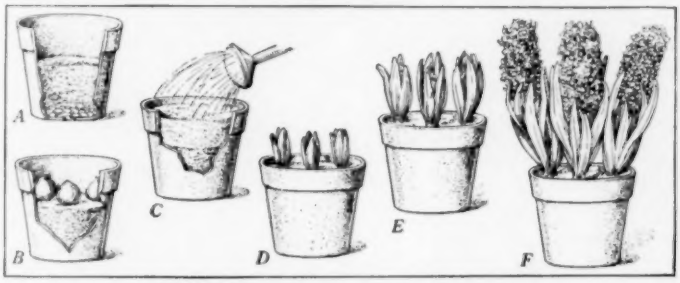

Fig. 105. Planting hyacinth bulbs.

A, pot partly filled with pebbles and soil; *B*, bulbs in place; *C*, bulbs covered with soil and watered; *D*, bulbs taken from storage; *E*, bulbs ready for sunlight; *F*, plant in full bloom. The bulbs should be planted in Autumn and stored in a trench outdoors, covered with leaves. They may be brought into the house in February or March, kept in a cool place for several days, and then placed in sunlight. See *Essentials of Biology*, pages 125–136. Note the vocabulary at the close of the chapter, the review questions for the discussion period, and the special problems which may be assigned to individual students.

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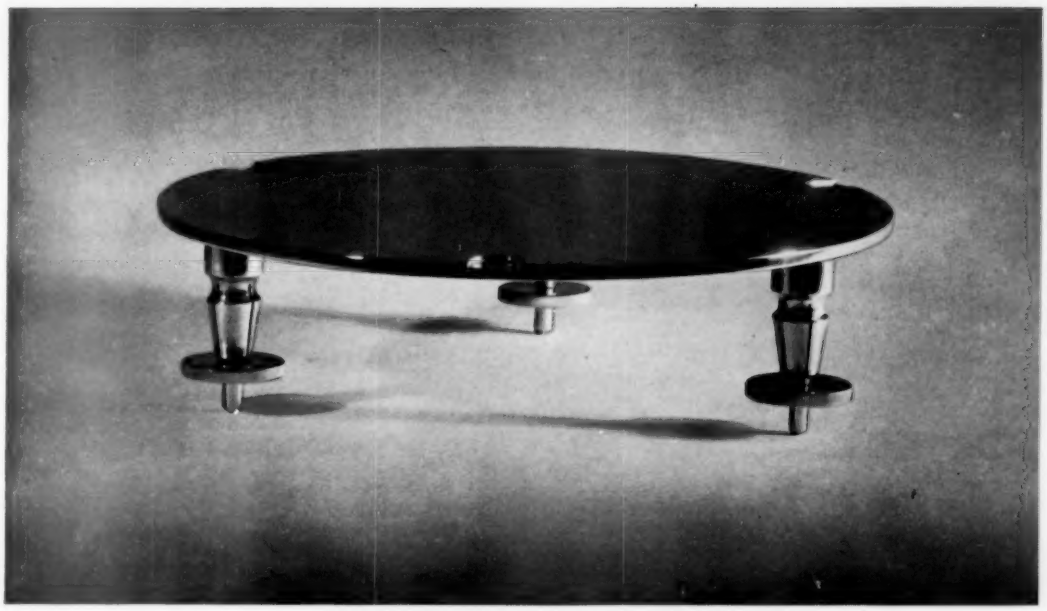

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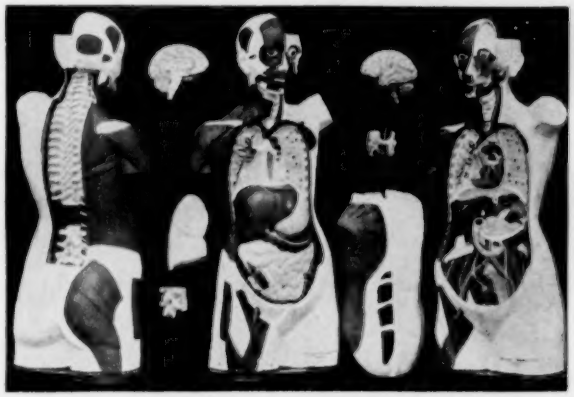

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